

## WHAT IS CLAIMED IS:

1. A method for fabricating an isolation layer in a semiconductor device, the method comprising the steps of:

- 5       forming a trench on a semiconductor substrate;  
          forming a flowing insulating layer within the trench;  
          making the insulating layer precise; and  
          forming a precise insulating layer over an upper surface  
of the whole structure on which the flowing insulating layer  
10 is formed.

2. The method as claimed in claim 1, further comprising  
a step of carrying out a pretreatment by an in-situ prior to  
forming the flowing insulating layer, wherein the  
15 pretreatment step is carried out by a cleaning treatment or a  
plasma treatment.

3. The method as claimed in claim 2, wherein the plasma  
treatment is carried out for at least 5 seconds at a pressure  
20 below 100 Torr with a plasma using  $\text{SiH}_4$ ,  $\text{SiH}_a(\text{CH}_3)_b$  (the value  
of a falls in the range of 0 ~ 4, and that of b falls in the  
range of 0 ~ 4),  $\text{N}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{O}_2$ ,  $\text{O}_3$ , Ar or He gas.

4. The method as claimed in claim 1, further comprising

a step of oxidizing sidewalls of the trench prior to forming the flowing insulating layer.

5        5. The method as claimed in claim 4, the oxidizing step is carried out at a furnace maintained at more than 600°C to form an oxide film ranging from 20 to 200Å.

10       6. The method as claimed in claim 4, further comprising a step of forming a nitride film within the trench according to an LPCVD or an ALD manner after oxidizing the sidewalls of the trench.

15       7. The method as claimed in claim 1, further comprising a step of sequentially forming a nitride film and an oxide film at an inner surface of the trench prior to forming the flowing insulating layer.

20       8. The method as claimed in claim 1, wherein the flowing insulating layer comprises an SHO ( $\text{SiO}_x\text{H}_y$ ; the value of  $x$  falls in the range of 0 ~ 3, and that of  $y$  falls in the range of 0 ~ 1) insulating layer.

9. The method as claimed in claim 8, wherein the flowing insulating layer using SHO is formed to a thickness

ranging from 50 to 5000Å.

10. The method as claimed in claim 8, wherein the SHO  
insulating layer used as a flowing insulating layer is formed  
5 by using a reaction source of  $\text{SiH}_4$  and  $\text{H}_2\text{O}_2$  by way of an in-  
situ according to an LPCVD process.

11. The method as claimed in claim 10, wherein the SHO  
insulating layer is formed at a temperature ranging from -10  
10 to 150°C and at a low pressure below 100 Torr using a  
reaction gas of  $\text{SiH}_4$ ,  $\text{SiH}_a(\text{CH}_3)_b$  (the value of a falls in the  
range of 0 ~ 4, and that of b falls in the range of 0 ~ 4),  
 $\text{H}_2\text{O}_2$ ,  $\text{O}_2$ ,  $\text{H}_2\text{O}$  and  $\text{N}_2\text{O}$  gas.

15 12. The method as claimed in claim 1, further  
comprising a step of post-cleaning the flowing insulating  
layer, wherein the post-cleaning step is carried out  
sequentially and simultaneously according to one or more  
methods selected from the following cleaning manners: 1)  
20 cleaning at a temperature ranging from room temperature to  
150°C with using a BOE (buffered oxide etchant) solution,  
which comprises an etching solution and a buffer solution in  
a ratio ranging from 3:1 to 500:1, or with using a mixed  
solution made of  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}_2$  solution in a volume ratio

ranging from 1:1 to 500:1, 2) cleaning by means of wet-etching with using SC-1 (standard cleaning-1), SC-2 (standard cleaning-2) cleaning solution after diluting with 5:1 ~ 500:1 HF.

5        13. The method as claimed in claim 1, wherein the step of making the flowing insulating layer precise is carried out in an atmosphere of O<sub>2</sub>, N<sub>2</sub>, O<sub>3</sub>, N<sub>2</sub>O, and H<sub>2</sub>+O<sub>2</sub> mixed gas at a temperature ranging from 300 to 850°C for more than 1 minute or carried out in an atmosphere of O<sub>2</sub>, N<sub>2</sub>, O<sub>3</sub>, N<sub>2</sub>O, and H<sub>2</sub>+O<sub>2</sub>  
10 mixed gas at a temperature ranging from 300 to 12000°C for more than 5 minutes or carried out by performing an RTP (Rapid Thermal Process) at a temperature more than 600°C for more than one second.

15        14. The method as claimed in claim 1, wherein the step of making the flowing insulating layer precise is carried out at a pressure ranging from 0 mTorr to 10 Torr and for more than 5 ~ 300 seconds by means of a plasma using SiH<sub>4</sub>, SiH<sub>a</sub>(CH<sub>3</sub>)<sub>b</sub> (the value of a falls in the range of 0 ~ 4, and  
20 that of b falls in the range of 0 ~ 4), N<sub>2</sub>, NH<sub>3</sub>, O<sub>2</sub>, O<sub>3</sub>, N<sub>2</sub>O, Ar or He gas.

15. The method as claimed in claim 1, wherein the precise insulating layer comprises a HDP film or a USG film.

16. The method as claimed in claim 1, further comprising a step of heat treatment of the resultant substrate after the formation of the precise insulating layer, wherein the heat treatment is carried out in an atmosphere of  $O_2$ ,  $N_2$ ,  $O_3$ ,  $N_2O$ , and  $H_2+O_2$  mixed gas at a temperature ranging from 300 to 12000°C for more than 5 minutes or by performing an RTP (Rapid Thermal Process) at a temperature more than 600°C for more than one second.

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17. A method for fabricating an isolation layer in a semiconductor device, the method comprising the steps of:

providing a semiconductor substrate on which a trench is formed;

15 carrying out a pretreatment of the trench;

forming a flowing insulating layer below the pretreated trench;

post-cleaning the flowing insulating layer;

making the insulating layer precise;

20 forming an insulating layer on an upper surface of whole structure on which the precise flowing insulating layer is formed; and

forming a thermal-insulating layer above the insulating layer.

18. The method as claimed in claim 17, further comprising a step of a plasma treatment or an annealing treatment prior to the post-cleaning treatment of the flowing  
5 insulating layer.

19. The method as claimed in claim 17, wherein the post cleaning step is carried out sequentially and simultaneously according to one or more methods selected from the following  
10 cleaning manners: 1) cleaning at a temperature ranging from room temperature to 150°C with using a BOE (buffered oxide etchant) solution, which comprises an etching solution and a buffer solution in a ratio ranging from 3:1 to 500:1, or with using a mixed solution made of  $H_2SO_4$  and  $H_2O_2$  solution in a  
15 volume ratio ranging from 1:1 to 500:1, 2) cleaning by means of wet-etching with using SC-1 (standard cleaning-1), SC-2 (standard cleaning-2) cleaning solution after diluting with 5:1 ~ 500:1 HF.

20. The method as claimed in claim 17, wherein the pretreatment step comprises a cleaning or a plasma treatment.

21. The method as claimed in claim 17, wherein the precise insulating layer is deposited by way of an HDP-CVD

manner using a  $\text{SiH}_4$  reaction gas or an AP-CVD, SA-CVD manner using a TEOS reaction gas.

22. The method as claimed in claim 17, wherein the  
5 insulating layer is formed by carrying out in an atmosphere of  $\text{O}_2$ ,  $\text{N}_2$ ,  $\text{O}_3$ ,  $\text{N}_2\text{O}$ , and  $\text{H}_2+\text{O}_2$  mixed gas at a temperature ranging from 300 to 12000°C for more than 5 minutes or by performing an RTP (Rapid Thermal Process) at a temperature more than 600°C for more than one second.

10 23. The method as claimed in claim 17, the thermal insulating layer is deposited by way of an HDP-CVD manner using a  $\text{SiH}_4$  reaction gas or an AP-CVD, an SA-CVD manner using a TEOS reaction gas.